years; thus averaging about 2·7 days annually. (The annual number of frost days is about 55.)

The year distribution is as follows:—

1841	7	1856	2	1871	3	1886	4
1842	—	1857	—	1872	—	1887	4
1843	—	1858	—	1873	—	1888	3
1844	1	1859	3	1874	3	1889	4
1845	4	1860	3	1875	1	1890	7
1846	3	1861	5	1876	2	1891	6
1847	6	1862	—	1877	—	1892	2
1848	1	1863	—	1878	3	1893	5
1849	2	1864	4	1879	5	1894	5
1850	—	1865	4	1880	5	1895	11
1851	—	1866	—	1881	10	1896	—
1852	—	1867	7	1882	—	1897	—
1853	1	1868	—	1883	—	1898	—
1854	2	1869	—	1884	—	1899	1
1855	14	1870	7	1885	—	1900	2
							162

The greatest number in any one year is 14, in 1855. Next come 1895 with 11, 1881 with 10, four with 7 each, &c. Considering *winters* instead of *years*, the highest number is 12, in 1854-55. On the other hand there are 22 years with none of these days, *i.e.* more than a third of the whole. We do not find more than *four* such years in succession; such a group is presented in 1882-85.

The distribution in months is as follows:—

Jan.	Feb.	Mar.	Nov.	Dec.	
68	42	5	2	45	= 162

Thus, January is *facile princeps*. February and December are nearly equal. The days are rare in March, and most rare in November. Of the two in November, one was on the 30th, in 1856 (19°·4), the other on the 28th, in 1890 (18°·3). The latest in March was on the 14th, in 1845 (13°·1).

Speaking roughly, we seem to have had an increase in those very cold days. Grouping in decades we find this:—

1841-50	1851-60	1861-70	1871-80	1881-90	1891-1900
24	25	27	22	32	32

The first three total 76; the last three 86. To put it otherwise, the thirty consecutive years ending 1895 had more of those days than any other thirty-year group.

Do these days present any definite relation to the sun-spot cycle? I think we may discern (as in the case of frost days) a tendency to greater cold before a maximum of sun-spots than after. This may be variously shown; here *e.g.* is one way:

Compare the group of years from the seventh after a maximum year to the next maximum year (inclusive) with the six years after the latter maximum. We may construct a table as follows:

	a Annual Average.		*b* Annual Average.	Relation *a* to *b*.
1844-48	3·0	1849-54	0·8	+2·2
1855-60	3·7	1861-66	2·2	+1·5
1867-70	3·5	1871-76	1·5	+2·0
1877-83	3·3	1884-89	2·5	+0·8
1890-93	5·0	1894-99	2·8	+2·2
				Av. +1·7

Thus the group of years ending with a maximum year shows an average which is always in excess of that of the six-year group following.

These very cold days are often found in groups. Among the longest are February 16-22, 1855, and February 5-10, 1895.

I may close with a list of the ten coldest days:—

		Min.
1.	January 9, 1841	4·0
2.	January 5, 1867	6·6
3.	February 8, 1895	6·9
4.	February 12, 1845	7·7 }
5.	January 4, 1867	7·7 }
6.	December 25, 1860	8·0
7.	February 7, 1895	9·6
8.	January 8, 1841	9·8 }
9.	December 25, 1870	9·8 }
10.	December 29, 1860	10·0

ALEX. B. MACDOWALL.

NATIONAL PHYSICAL LABORATORY.[1]

THE first annual report of the Executive Committee of the laboratory, which was laid before the Royal Society at its annual meeting, is in some respects disappointing. It contains a record of much valuable labour, rendered useless by the opposition to the site on the Old Deer Park at Richmond, which had been selected for the laboratory; while the delays caused by that opposition have made the progress of the scheme very slow.

The Richmond site was chosen by Lord Rayleigh's committee, and approved by the Treasury; the director's first task, after taking up his duties, was to visit the Reichsanstalt and the Bureau International at Sèvres. The courtesy of the authorities of these two institutions is suitably acknowledged in the report, and is another evidence of the international character of science. Meanwhile, in order that the new laboratory might, from the beginning, adapt itself to real wants, various committees had been considering the questions which seemed to press most urgently for solution. With their reports before them, the executive committee prepared plans, and authority was given in June last to obtain tenders for the work. Then followed a delay of some four months. During the summer a deputation from the Royal Society waited on Mr. Hanbury, urging that the original scheme should go on; but towards the end of October it was announced that Her Majesty had been graciously pleased to assign Bushy House and grounds for the purposes of the laboratory, and that in order to meet the additional capital expenditure involved, the Government were prepared to ask Parliament to raise the grant of 12,000*l.* for building to 14,000*l.* This was accepted by the Council of the Royal Society, but it was pointed out that, to quote the words of the report:—

The executive committee "cannot, however, conceal from themselves that it will be very difficult for them to maintain and administer a national physical laboratory on the Bushy site for the amount annually allowed by the Treasury, and they fear that it may be necessary for them to press, in the near future, for an addition to that allowance."

Meanwhile, plan-making had to begin again. With the very cordial assistance of the Office of Works a new scheme was prepared and approved, and now the workmen are on the ground and the alterations have commenced.

Fortunately, the structural changes necessary will be remarkably small.

Bushy House is in many respects well suited, as it stands, for a physical laboratory; the basement, however, was dark and damp, and the whole sanitary arrangements needed reconstruction. The basement is to be improved by the construction of a dry area round the house, and the insertion of larger windows; the present flagged floor is to be removed, and to be replaced by concrete and cement. Modern drainage is to be introduced everywhere, and in place of the cess-pools now in use, connection is to be made with the public sewer; this necessitates a main drain some 300 yards long.

The house itself consists of a central block about 70 feet square, containing a basement and ground floor with two floors over. The ground floor rests on brick groining, forming the roof of the basement; it is thus possible to secure steady supports for apparatus at almost any point; the building is very substantial, and it will be easy to maintain a uniform temperature throughout the basement.

The front of the house faces east approximately; unfortunately, the two main rooms of the central block on the first floor look south and west respectively; in

[1] Report of the Executive Committee for 1900, and Programme of Work for 1901.

other respects they will make good laboratories, requiring only the provision of some steady supports, and, in common with the rest of the house, arrangements for heating and for the supply of gas, water and electricity for light and power.

But besides this main block, which is some 50 feet in height, there are five large wings, one at each corner and a fifth adjacent to the north front. This fifth wing, three stories in height, contains a number of small rooms, which will be of service for special pieces of work; the other four wings give the main laboratory accommodation. Two of these each contain two large rooms about 35 feet long by 25 broad—one of which has been subdivided—the other two are of about half the size, and contain one room each of the above dimensions. All these rooms are on the ground; they have excellent floors, and are in the main well lighted; in each wing there is considerable space between the ceiling and the roof; in two of the wings this space contains attic rooms. Thus omitting the room which has been subdivided, there are five large laboratories on the ground floor in the wings, and two in the central block. There are, in addition, a number of while some existing buildings will be utilised for a battery-room, a drawing office, and for other purposes. To the north of these buildings stand, at a distance of about 100 yards, the house. To minimise the risk of vibrations from the engine being felt to enter the physical laboratory, a Parson's Turbo-Generator will be used to provide light and power, and the latter will be transmitted electrically. The engineering laboratory will have a traversing crane fitted, and will contain the main workshop of the Institution.

The grounds of Bushy House, under the direct control of the Royal Society, are nearly twenty-five acres in extent; it will be possible, therefore, to put up, if required, isolated buildings for special experiments; the use, for example, of a large testing machine in the engineering laboratory might shake the physics laboratory, and would certainly disturb many of the experiments in the engineering laboratory itself. At present the funds available are insufficient to permit of the purchase of such a machine; if it is found that one is wanted, and money were forthcoming, the necessary buildings could be erected in another portion of the grounds.

[Photo. by Lascelles London.

FIG. 1.—National Physical Laboratory. Bushy House from the East.

other smaller rooms, and at the back various kitchen offices, which can easily be rendered most useful.

This general plan has some distinct advantages; it is not unlike Principal Lodge's ideal laboratory, a central block to serve as a museum, entrance-hall, offices, &c., with four wings assigned to definite branches of the work. Each wing is isolated from the others, and the chances of an observer being affected by his colleague in the next room are reduced. At the same time the difficulty of supervision is increased, while the fact that the levels are different in the wings and in the main building renders the transport of apparatus a matter of some trouble.

Our illustrations give a view of Bushy House from the east and a plan of the ground-floor.

This building will serve then for the more delicate physical measurements. For the engineering work a new laboratory is to be built; this will be 80 feet by 50 feet in area, with a weaving-shed roof lighted from the north and arranged so as to be easily capable of extension. Adjacent to it will be an engine and dynamo-room,

Together with their report the Committee presented a scheme of work for the current year.

The experimental work, which it is possible to do with the appliances at the Kew Observatory, is small; still it is hoped to increase the testing work which goes on there. Arrangements are being made for examining chemical measuring apparatus, flasks, burettes, and the like, and also, at the request of the Board of Agriculture, the bottles used in the Babcock milk test. An air thermometer, given by Sir A. Noble, has been erected, and will be in use as a standard of temperature up to about 400° C., while preparations are being made for the construction of mercury standards of resistance.

As to work for the future, which is to be taken up when Bushy House is occupied, the subject to which three, at least, of the Advisory Committees gave the first place was the connection between the magnetic quality and the physical, chemical and electrical properties of iron and its alloys, with a view specially to the determination of the conditions for low hysteresis and non-agency

properties. This problem, then, will, as soon as possible, be taken in hand.

Another important task is the testing of steam gauges, indicator springs and the like; for this purpose a mercury pressure gauge will be provided in the physics building to measure pressures up to twenty atmospheres —the height of the building will not allow more to be measured directly—together with an arrangement for multiplying in a known ratio the pressure measured directly.

Again, gauges of all kinds used in engineering practice will be tested, including the standard screws which the Small Screw Committee of the British Association hope to issue. Another problem which calls for early attention is that of wind pressure on surfaces.

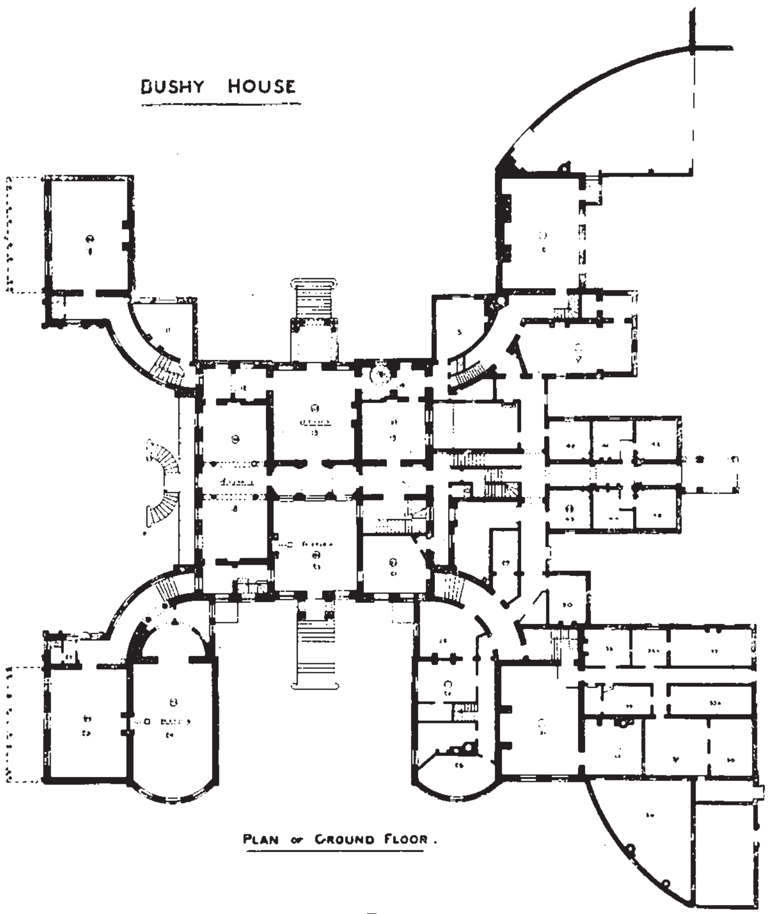

FIG. 2.

In electricity there is ample scope for work. The magnetic testing of iron for commercial use will be undertaken at once, and there are many forms of apparatus which do not come under the direct cognisance of the Board of Trade Electrical Department for which it is desirable to have some recognised test—*e.g.* condensers, special forms of cells, resistance boxes as distinct from standard coils and the like. A valuable list of measurements, by which the work of the Board of Trade Laboratory would be supplemented and assisted, has been submitted to the committee by Mr. Trotter.

Optical and thermometric testing is now carried out to a large extent at Kew Observatory, but both these branches of the work can be extended; the question of the measurement of very high and of very low temperatures is becoming more important each day. In the Optical Department photographic lenses are now tested by eye observations only. It is proposed to establish a photographic test, and to include microscope and other lenses.

It will be seen thus that there is a full programme of work before the staff of the laboratory; the Committee are anxious to keep in the closest touch with trade and industry, and the Director will welcome any suggestions to secure this end. The laboratory has been established to deal with physical problems bearing on manufacture and commerce; it can hope to succeed only through the cordial co-operation of the men who know what those problems are, and who can indicate the lines along which the necessary investigations should proceed; with their assistance it may soon do a national work.

THE PRESENT CONDITION OF THE INDIGO INDUSTRY.

FOR some time past letters on the subject of artificial *versus* natural indigo have been appearing in the *Times*. One by L. J. Harington, which appeared at the end of last month, is of considerable interest, since he writes as a planter of nineteen years' experience. He considers that the days of natural indigo are not numbered, and that the Government of India are not likely to take the advice of Dr. Brunck (NATURE, p. 111) and endeavour to grow food stuffs in place of cultivating indigo. He further remarks that "there is so little to choose between artificial and natural indigo that the whole thing is a matter of price, and the victory must go to the one who can afford to sell cheapest." He then goes on to say: "Indigo had always paid, at times well, at other times fairly so, and planters were content to grow and manufacture indigo exactly as their predecessors had done. Then in 1897 the Badische discovery came like a bolt from the blue." This is a rather remarkable admission. Here were men manufacturing indigo, and they had evidently not taken the trouble to ascertain what was being done in the scientific world and by other manufacturers. Were they not aware that so far back as 1880 indigo had been synthetically prepared, and that numerous patents had been taken out? Certainly the processes had not been commercially successful; but surely they should have taken warning, and endeavoured to improve their product and to manufacture it more cheaply.

Mr. Harington says that after the "bolt from the blue" in 1897 the price of indigo steadily fell until 1899, when, owing to the bad season, one of the finest crops ever seen in Behar was ruined and the price rose nearly 25 per cent. This naturally gave the producers of artificial indigo their chance, and they were able to offer their product at prices slightly lower than those ruling for the natural article. According to Mr. Harington, when synthetic indigo was first placed on the market the average cost of manufacturing Behar indigo was 170 rupees per maund, but that now, owing to more careful working and by sowing only on good lands, it